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ABSTRACT

This illustrated leader's guide to exploring trees and forests provides activities which emphasize careful observation of trees and the living things associated with them for youths age 9 and older. Introductory information for leaders explains the uses for trees and the role of trees in the ecosystem. It also gives suggestions for leaders to encourage learning and ensure safety. Following a section called "Fascinating Facts about Trees and Forests" are questions to stimulate thought in groups of young people. The seven activities in the guide are divided into three sections. In Section 1, the group discovers how trees grow. Section 2 introduces the group to the community of plants and animals that live in and on trees. The activity in Section 3 encourages group members to think about how a forest will look many years into the future. Many of the activities require field trips to wooded areas. Each activity contains: (1) background information; (2) an objective; (3) a list of materials needed; and (4) detailed instructions to complete the activity. At the end of the guide are reproducible record sheets for each activity, a list of suggested field trips and activities, a glossary, and references. (KS)

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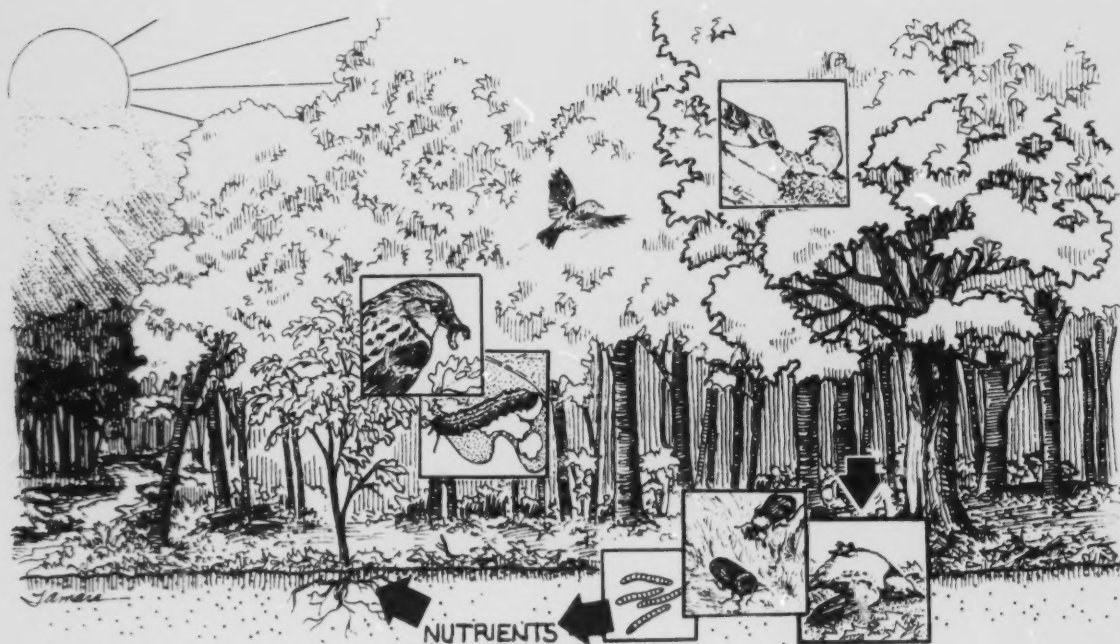
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Trees: Dead or Alive

Marianne E. Krasny



4-H Leader's Guide 147-L-22

A Cornell Cooperative Extension Publication

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Contents

Introduction	1
Section 1. The Growing Tree	10
Activity 1: Trees and Water	10
Activity 2: Tree Rings	12
Activity 3: Tree Roots	17
Section 2. Tree Homes	19
Activity 4: Live Tree Homes	19
Activity 5: Snags	21
Activity 6: Rotting Logs	24
Section 3. The Future Forest	26
Activity 7: Forest Gaps	26
Activity Records	28
Trees: Dead or Alive Project Record	40
Suggested Field Trips and Activities	42
Glossary	43
For Further Information	44

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The following publication was particularly useful in preparing this guide:

Rockcastle, Verne N. *What's a Tree to Me?* Washington, D.C.: National 4-H Council, 1981.

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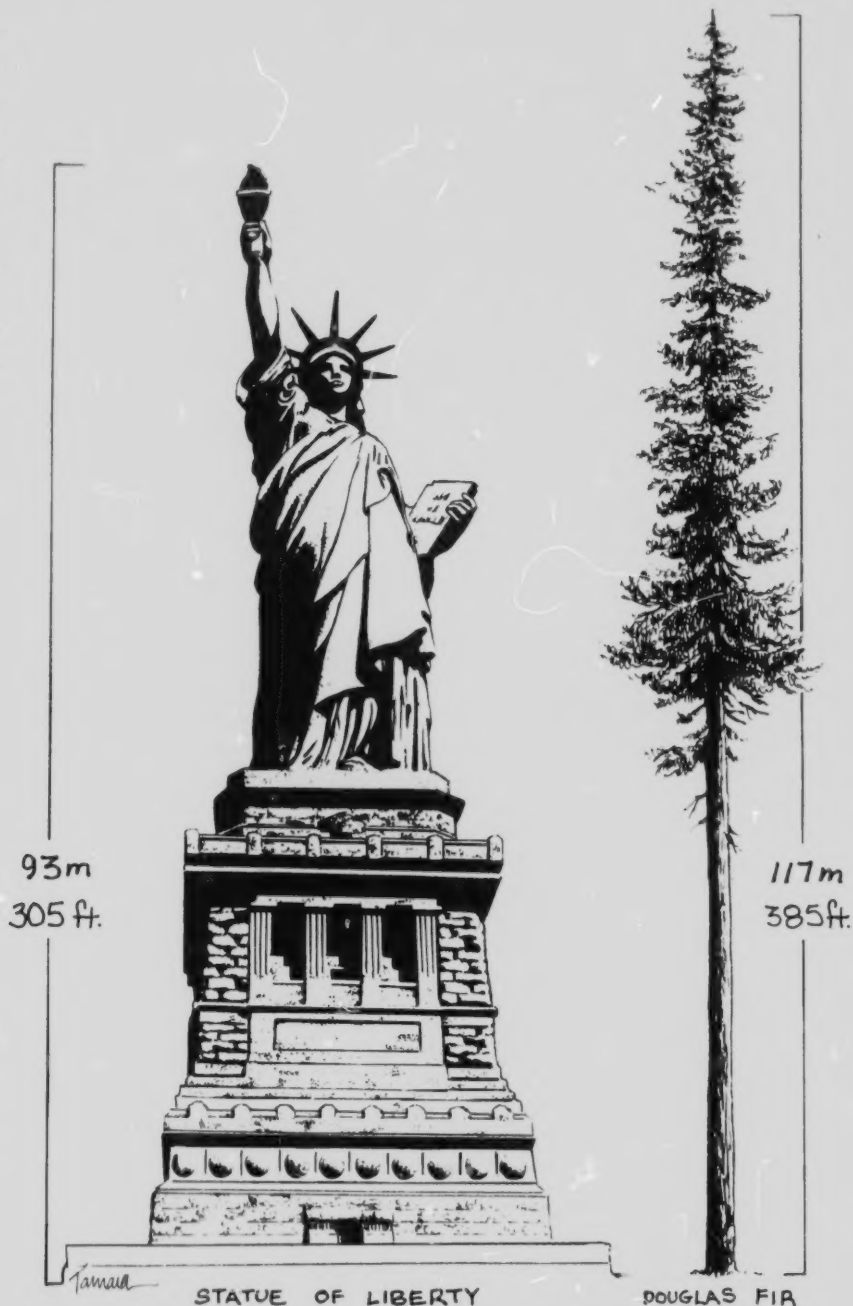
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Introduction

What can be less than a foot tall or taller than the Statue of Liberty? What can be 4,500 years older than your grandparents? What can keep a house 20 percent cooler in summer? What can grow in a sidewalk crack or on a mountain slope?

A tree, of course! Different kinds of trees can do all these things and much more. For example, a large tree with many leaves takes up almost a ton (907 kilograms) of water from the soil in a single day.



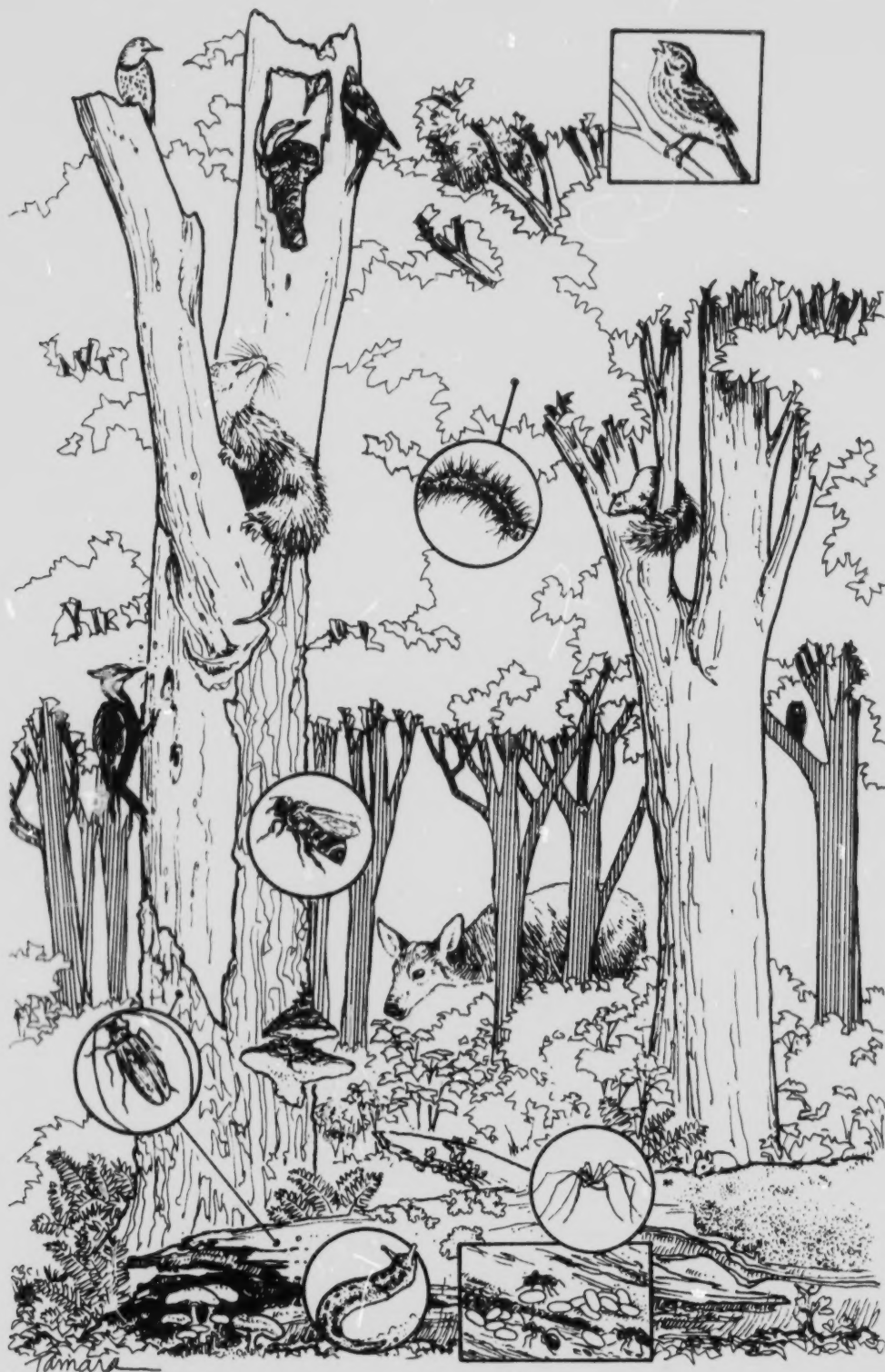


Trees also provide humans with many useful products, including lumber, fruits, nuts, spices, maple syrup, paper, fuel, and corks. Other wood products are cellulose, which is used to make rayon fabric and photographic film, and gums and resins, which are used to make different products such as perfumes, rubber, cosmetics, paint thinner, and coatings for pills.

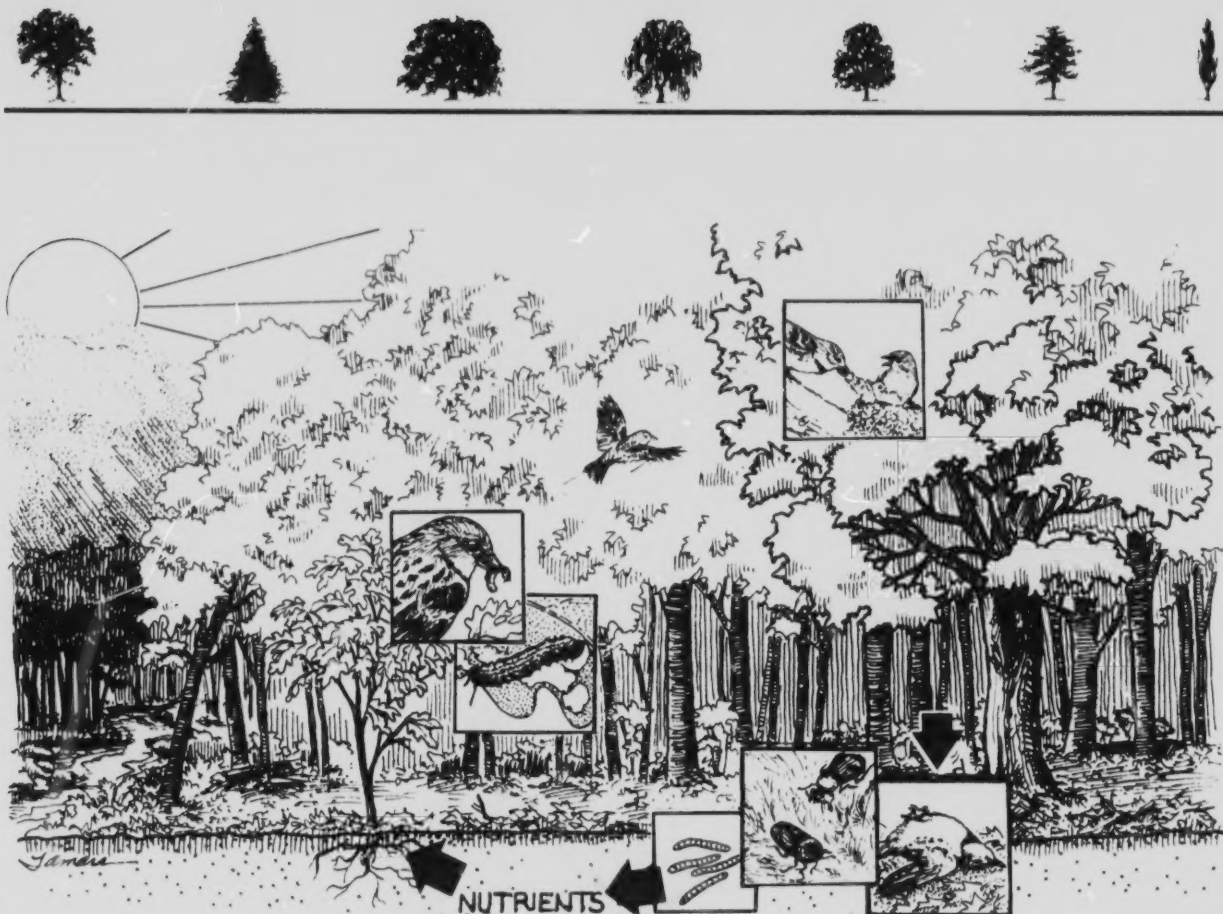
Just as trees are valuable to humans, they also are essential to the natural communities in which they live. Both live and dead trees provide homes for many animals, including raccoons, woodpeckers, snakes, salamanders, beetles, and spiders. They also provide homes for many plants, such as fungi (mushrooms), mosses, algae, and lichens.

The plants and animals that live on a live healthy tree are different from the plants and animals that make their home in a dead, rotting log.

Various plants and animals, together with nonliving things in nature, such as water, sunlight, air, and soil, form an ecosystem. A forest ecosystem is dominated by trees. Trees continuously interact with other plants and animals and with nonliving things. For example, trees take up nutrients from the soil and use them to grow leaves. Insects eat the leaves, and the insects, in turn, are eaten by birds. When birds, insects, and trees die, microscopic plants and animals in the soil break them down into soil nutrients. These nutrients then are taken up by trees and other plants.



Live trees, dead trees (snags), and rotting logs provide homes for different animals and plants in the forest.



There are many interactions between plants and animals in a forest ecosystem.

Because there are so many interactions in a forest ecosystem, it is difficult for forest scientists to predict what effect a change in one part will have on the total ecosystem. For example, it is difficult to predict the effects of acid rain on the soil, trees, streams, and aquatic life, or what will happen if global warming causes temperatures to rise.

In this project, you will help youth discover the fascinating world of trees and forests. The activities emphasize careful observation of trees and the living things associated with them. Several references are included at the end of this publication for those who wish to explore other approaches to learning about nature.

The activities in this guide are divided into three sections. In Section 1, you and the youths in your group will discover how trees grow. Section 2 intro-

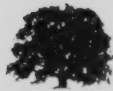
duces you and your group to the community of plants and animals that live in and on trees. The activity in Section 3 encourages you and your group members to think about how a forest will look many years in the future. Many of the activities require field trips to wooded areas. In urban areas, the activities can be conducted in city parks. The record sheets for each activity are located near the end of this guide.

Getting Started

This guide is for youth group leaders, camp counselors, teachers, and parents who have little or no background in the study of trees. The short introductions to each activity will prepare you to help youth learn the basic principles of tree and forest life. A glossary is included at the end of the publication.

The activities in this project are suitable for youths nine years old and older. Each activity can be accomplished in about an hour, although you may want to stretch out certain activities for a longer time. The activities are presented in a logical sequence; however, you do not need to conduct all the activities to provide a meaningful experience for youth.

Each activity begins with a short introduction giving background information and the important concepts covered. Use the list of materials and step-by-step instructions to help you conduct the activity. Don't be afraid, however, to stray from the lesson plan. Let your group—and the trees—lead you.



Encouraging Learning

If a member of your group asks a question you can't answer, don't be afraid to say, "I don't know." Try to think of ways in which you can guide the youth to find his or her own answer. Follow the example of a teacher of the great naturalist Liberty Hyde Bailey. Upon becoming aware of young Bailey's interest in nature study, the teacher admitted that she knew little about science but suggested they could learn together. She asked him how many trees grew along his route to school, so he counted them. Then she asked what kinds of trees they were, and he set off to find out. With his teacher's guidance, Bailey began what was to be a lifelong exploration of natural science, despite (or perhaps because of) his teacher's professed ignorance.

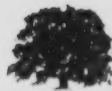
The activities in this guide give an enjoyable, active introduction to the study of trees and forests. The youths in your group will not have to memorize the names of trees or become experts on how trees grow. Rather, if the members learn to appreciate the uniqueness of trees and their important role in the natural world and want to learn more on their own, the project will have been a success.

The more interested members of your group may want to pursue additional 4-H projects. The 4-H guides *Know Your Trees*, *Know Your Tree Diseases*, *Understanding Forest Ecosystems*, and *Nature Trails* may be of particular interest. These and other activity guides are listed at the end of this publication.

Safety

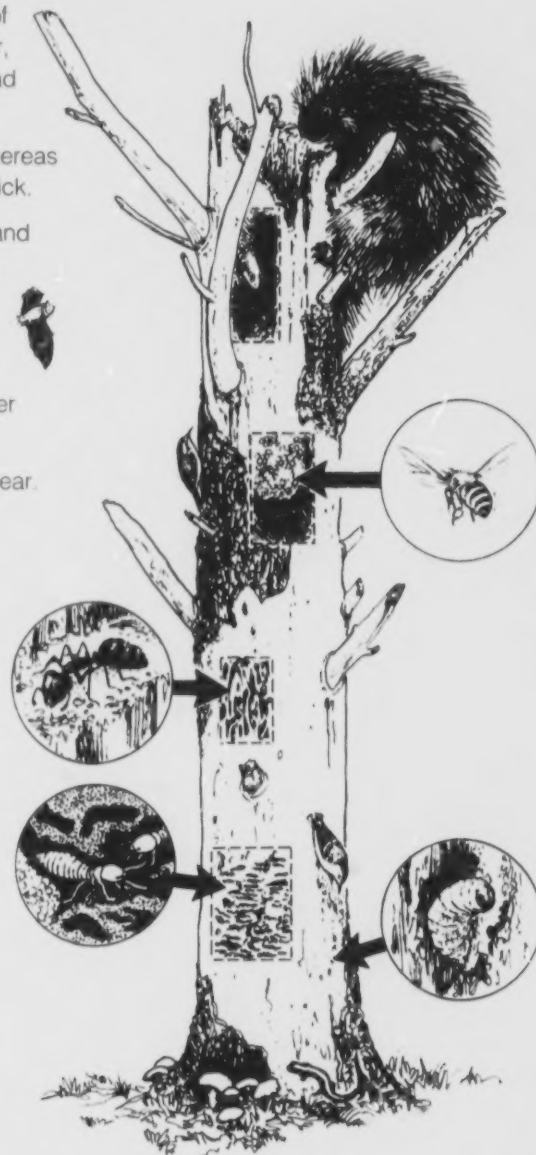
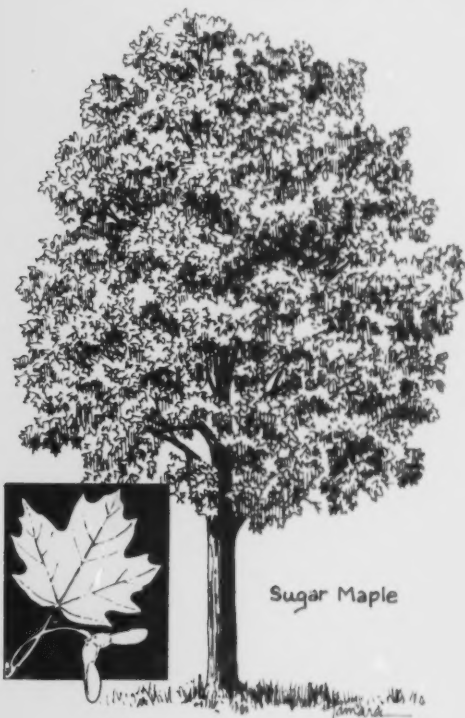
Several activities in this guide involve the use of knives. Be sure to caution your group members about the proper use of knives. Instruct them to cut away from their body and to be sure no one is directly in front of them. When they pass a knife to another person, tell them to grasp the knife blade carefully and offer the handle to the recipient. Knives should always be folded or put in a protective sheath when not in use, never left lying around. Be sure the youths are properly supervised whenever they use knives.

Some activities involve being around dead trees. Be sure to conduct these activities on a calm day to reduce the risk of injury from falling branches. Do not let the members of your group climb on dead or diseased trees.



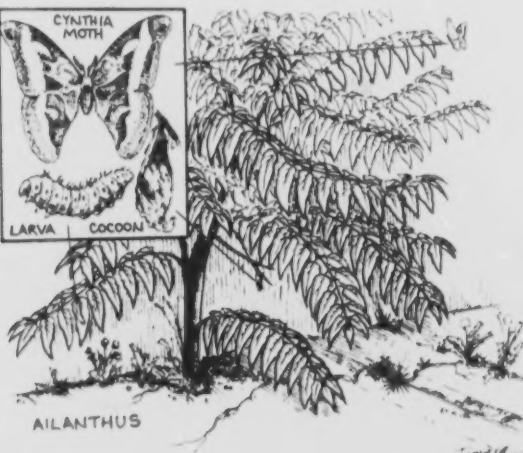
Fascinating Facts about Trees and Forests

- In North America, 17 bird species make nest cavities in trees. Another 80 animal species live in either natural tree holes or cavities that birds have made.
- In North American forests, 65 species of birds, 30 species of mammals, and 2 species of amphibians use dead trees for shelter, food, and raising their young. Numerous insects also live in dead trees.
- The bark of a beech tree may be less than 1/4 inch (6 mm) thick, whereas the bark of a giant sequoia may be as much as 2 feet (61 cm) thick.
- Mushrooms (fungi) can help trees grow. They live on tree roots and help trees take up nutrients from the soil. At the same time, trees provide sugars mushrooms need to grow.
- Baseball pitchers used to chew slippery elm seeds, then rub their spit on the baseball. The resulting pitch was called a "spitball," and when hit, the ball did not go very far. Spitballs are no longer allowed in baseball.
- In the United States, more than 100,000 forest fires occur each year.
- The sugar maple is the most common tree in New York State.





- The tree with the largest circumference in New York State is a Chinese wingnut. It has a circumference of 35 feet 2 inches (10.7 m) and is located in Nassau County, Long Island.
- The tallest tree in New York State is a white pine. It is 160 feet (49 m) tall and is located in St. Lawrence County near the Canadian border.
- The tallest tree ever measured in the United States was a Douglas fir in Washington State. It was 385 feet (117 m) tall—taller than the Statue of Liberty and longer than a football field. It was cut down in 1945.
- Three well-placed, mature trees around a house can cut air-conditioning costs by 50 percent as well as increase property values.
- New York State forests have been cut as many as six times. Of the few uncut patches of forest left today, one of the largest is a stand of hemlock trees in the New York Botanical Garden in the Bronx, New York City.
- An average of 43 gallons (163 liters) of sugar maple sap are needed to make 1 gallon (3.8 liters) of maple syrup.
- The average American uses the equivalent of one tree 100 feet (30 m) tall and 16 inches (41 cm) in diameter to fulfill his or her wood and paper needs each year.
- The ailanthus tree, also called tree of paradise, can grow in a sidewalk crack or abandoned railroad yard. It provides a home and food for the beautiful Cynthia moth.





Questions to Stimulate Thought

Before you begin the activities in this guide, ask the youths in your group the following questions to start them thinking about trees. Possible responses are included.

Why are trees important?

- Trees muffle noise in cities.
- Trees reduce pollution.
- Trees convert carbon dioxide to oxygen, which is essential for animals to breathe.
- Trees are the source of many useful products, including baseball bats, materials for building houses and furniture, paper, maple syrup, fuel, turpentine, rubber, and many foods.
- Trees provide food and shelter for animals.
- Trees reduce soil erosion.
- Trees provide shade on hot days.
- Trees provide wind breaks.
- Trees growing along streams shade the water and keep it cool for fish to grow.

What do trees need to grow?

- water
- proper temperature
- light
- nutrients
- air (carbon dioxide and oxygen)

What do animals need to survive?

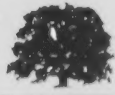
- places to hide from predators
- shelter from cold and hot temperatures and from storms
- food
- water
- air (oxygen)

How are trees different from other plants?

- Trees generally live longer than other plants.
- Trees are usually larger than other plants.
- Trees usually have only one main stem.
- Trees have hard, woody tissues.

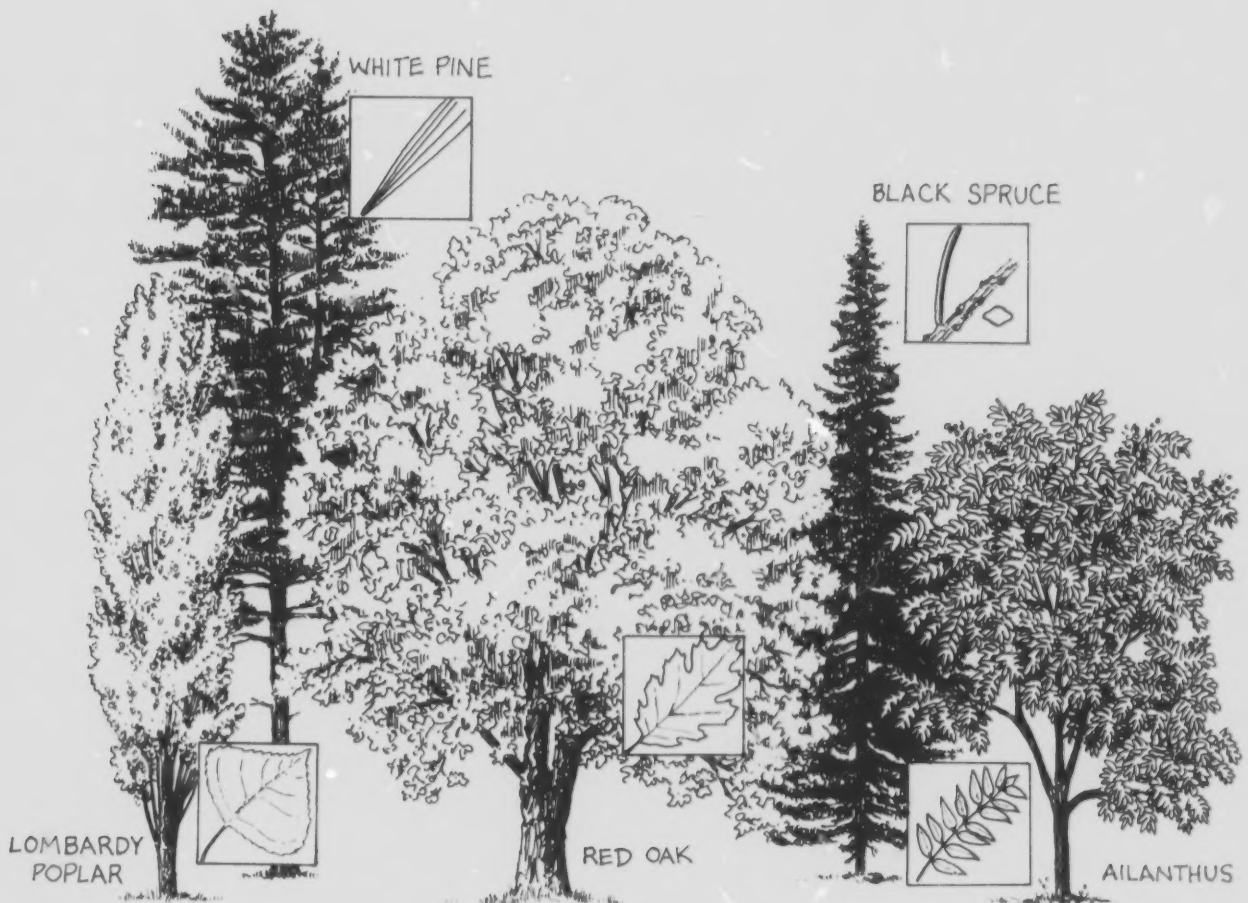
What might you find living on or in a tree?

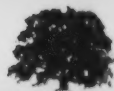
- insects (bark beetles, scales, aphids, wood-boring beetles)
- birds (woodpeckers, grosbeaks, owls, hawks, crows)
- mammals (bats, raccoons, squirrels, opossums, chipmunks, porcupines)
- reptiles (snakes)
- amphibians (frogs, salamanders)
- lichens
- fungi (mushrooms)
- mosses



What kinds of trees are in your yard?
Your school yard? Along your street?

- maple
- poplar
- aspen
- sycamore, or plane tree
- pine
- spruce
- tulip tree
- oak
- ailanthus
- horse chestnut
- magnolia
- cherry
- birch
- beech
- hemlock
- apple





Section 1. The Growing Tree

Activity 1: Trees and Water

Water is one of the most important things trees need to grow. Water is taken up by the roots of the tree. It then travels up through the trunk, to the branches, and finally to the leaves. As it travels through the tree, water carries essential minerals to the cells of the tree. Water is also used for various processes in the tree such as growth and photosynthesis. Through photosynthesis, green leaves convert the sun's energy to sugars used in growth.

When water reaches the leaves of a tree, it passes out from the leaves to the air in a process called transpiration. When trees transpire, they lose water from the leaves to the air. On sunny, warm days, trees are more active and therefore use more water in growth and photosynthesis. They also transpire more rapidly. As water passes out of the leaves, more water is pulled in through the roots and up the trunk.

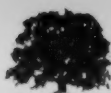
It is hard to believe that water can travel from the roots below the ground to the leaves at the top of a tall tree. In this activity, you and your group will conduct a simple experiment to learn how water travels through a branch. You may want to conduct the activity as a demonstration before the youth do it themselves. After setting up the experiment, you will need to wait an hour or so to see the results. This activity is conducted outdoors.

What Youth Discover

- Trees take up and give off water.

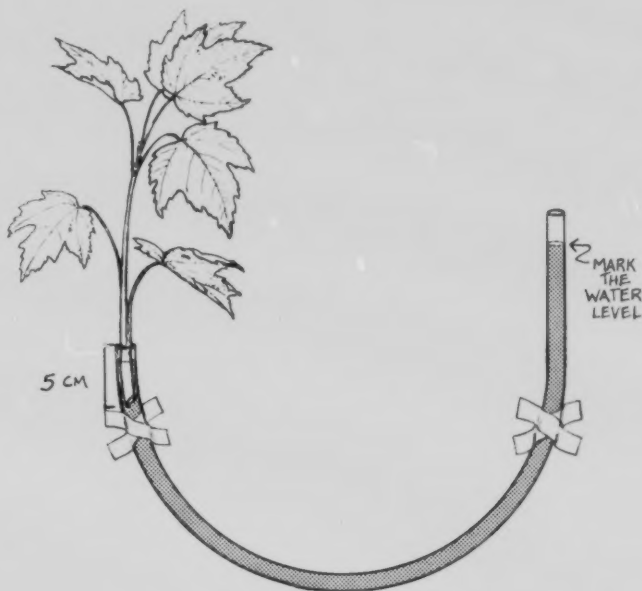
What You Need

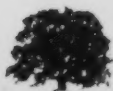
- lengths of flexible, clear plastic tubing, each about 3 feet (91 cm) long and 3/8 inch (9.5 mm) in diameter, available from a hardware store
- red food coloring (optional)
- masking tape
- pruning shears or scissors
- a waterproof marker
- copies of the Trees and Water Activity Record for each group member



What to Do

1. Hand out a copy of the Trees and Water Activity Record to each youth. Ask the youths to work in pairs.
2. Have each pair of youths bend the length of plastic tubing into the shape of the letter U. Have them fill the plastic tube with water by holding one end under a faucet and the other end up so the water does not run out. (Optional: Before adding water, put 4 drops of red food coloring in the tubing.)
3. Have each pair tape their U-shaped tube at both ends to a wall on the outside of a building. One end of the tube should be several inches higher than the other. The wall should be in a warm, sunny place to promote leaf activity, including photosynthesis. (The amount of water that is lost due to transpiration will increase when the leaves are more active.)
4. Have the youths cut green, leafy branches—1 to 2 feet long (30 to 61 cm) and about 3/8 inch (9.5 mm) in diameter—from several different broad-leaved trees.
5. Have each pair quickly insert the end of a branch about 2 inches (5 cm) into the water in the lower end of the tube. There should be no air between the branch and the water.
6. Have each pair mark with a waterproof marker the water level on the tube end without the branch.
7. As a control for evaporation, you may want to set up a tube with no branch in it. Simply tape a tube filled with water to the wall in a similar position to the tubes with the branches. Cover with masking tape the end that would have held the branch and mark the water level at the other end.
8. After an hour or more, have the youths check the water levels in the tubes. They can tell how much water was lost by measuring the distance between their original marks and the new water levels.
9. If the youths used colored water, have them remove their branches from the tubes and peel off the bark along the stem. Has colored water been carried up the stem?
10. Use the same procedure to compare water loss to branches in sunny and shady spots and on cool and warm days. Or repeat the experiment with different kinds of trees and with branches without leaves.
11. Have each youth complete the Trees and Water Activity Record.





Activity 2: Tree Rings

In Activity 1, you and your group saw how tree branches take up water. Now you and your group will study the trunk of the tree and learn how trees grow.

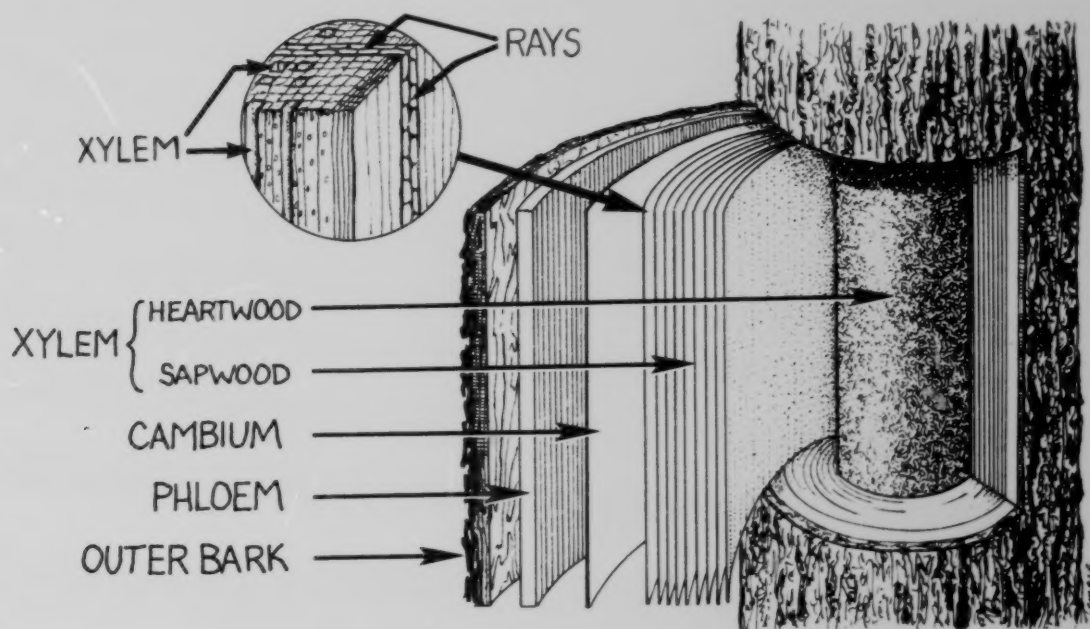
In the outer region of the tree's trunk—an area known as the sapwood—a layer of cells transports water up the tree. This layer is known as the xylem. Each year, new xylem is formed on the outside of the xylem formed the previous year. Only the xylem formed in the most recent years is able to transport water.

Outside the xylem is a thin layer of cells called the cambium. These cells produce the xylem. They also produce a layer of cells called the phloem, which is found just under the bark. The job of the xylem is to bring water up the tree from the roots to the trunk, branches, and leaves. The job of the phloem is to bring sugars produced by the leaves down to the branches, trunk, and roots. Outside the phloem is the bark, which protects the tree from injury and disease.

On large trees, the bark, phloem, cambium, and new xylem together make up only the outermost few inches, or centi-

meters, of the tree trunk. Most of the trunk of the tree is old xylem, or heartwood, in the center of the trunk. The heartwood is often darker in color than the young xylem. Heartwood is no longer living and cannot transport water up the tree. The heartwood is important, however, because it supports the tree.

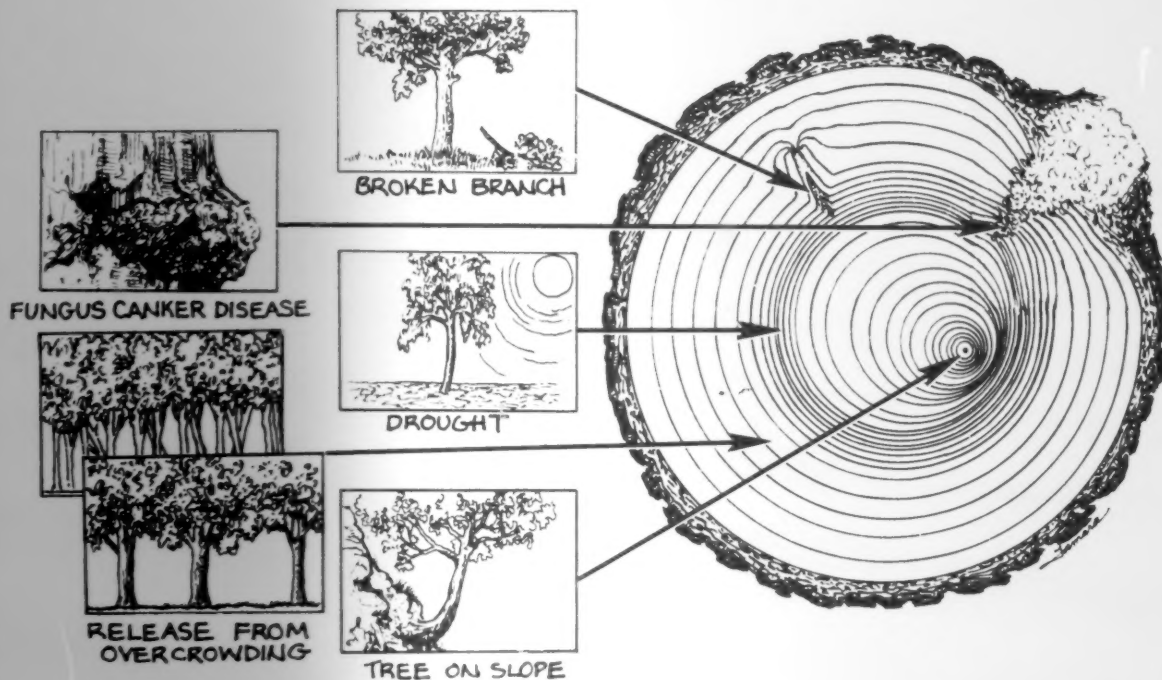
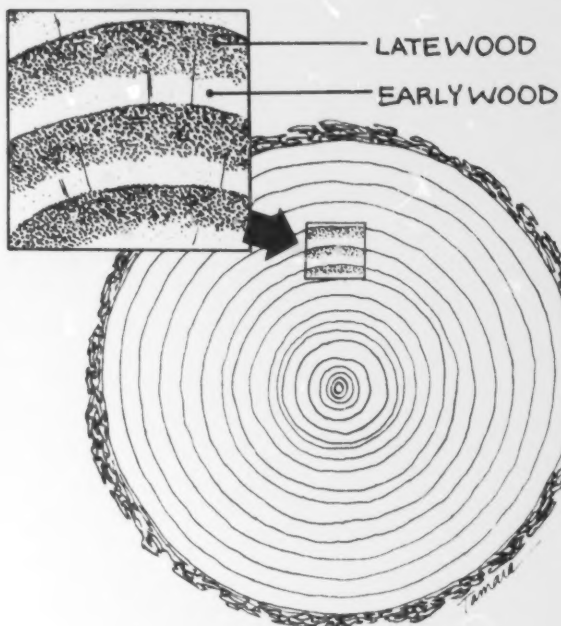
When looking at a cross section of a tree trunk, such as the stump left after a tree is cut down, you can see a pattern of rings. The xylem is responsible for this pattern. In the spring, the tree grows quickly and produces a light-colored band of xylem called earlywood. As

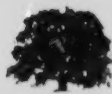




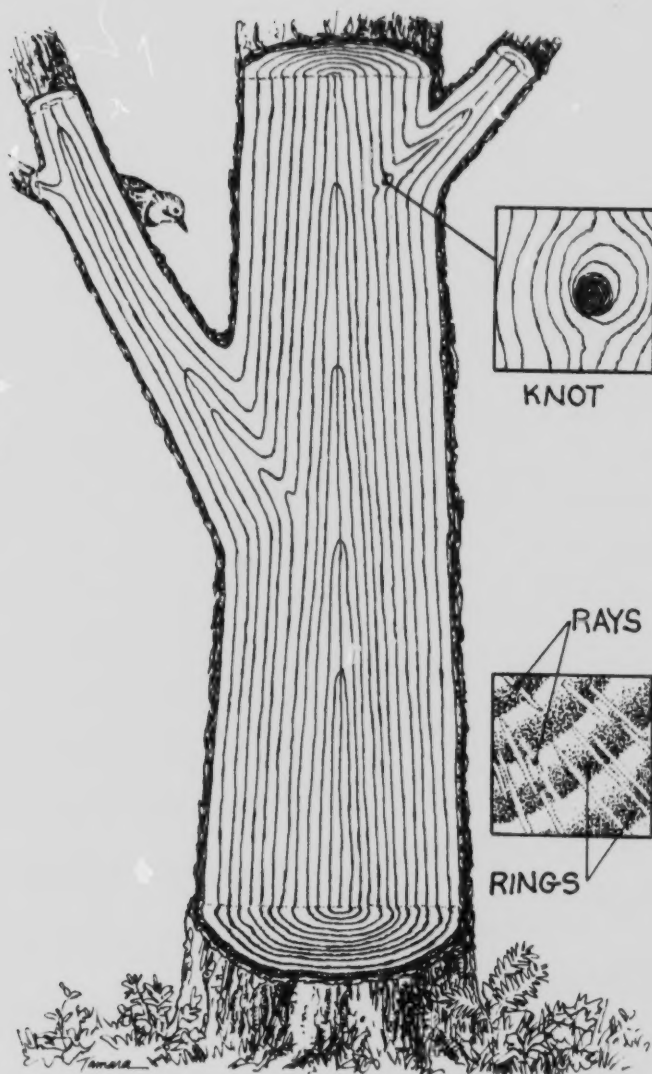
growth slows in the summer, darker xylem, known as latewood, is formed. Together, the bands of light earlywood and dark latewood make one ring in a cross section of a tree trunk.

You can learn a lot about a tree by looking at a cross section of its trunk. You can determine its age by counting the rings, allowing one ring for each year. You also can learn something about the life of the tree by examining the rings. For example, narrow rings indicate bad growing conditions, such as drought, freezing temperatures late in the year, or heavy insect damage. Uneven rings could mean that the tree was leaning against another tree, growing on a slope, or shaded on one side.





Looking at a tree stump or a cross section of wood in a piece of furniture, you may notice lines going between the rings. These are formed by the rays of the tree. Rays store food for the tree and transport food across the rings between the phloem and the heartwood.



When a tree is cut lengthwise to form boards, as opposed to crosswise when it is cut down, the rings are seen as lines that go up and down. The rays appear as lines perpendicular to the lines of the rings. Plywood or veneer is formed by peeling the trunks of trees into thin lengthwise sections. Sometimes the lines you see in plywood are very far apart because of the way the log was peeled.

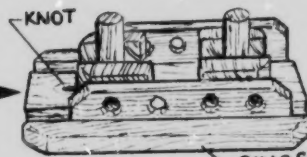
Knots occur on boards or pieces of plywood that were cut from where a branch was growing out of the trunk. Branches, like tree trunks, have rings. Because the trunk of the tree was pushing against the branch, the rings of knots are usually very close together. This makes knots hard.

Each species of tree has a characteristic pattern of rings, knots, and rays. These attractive patterns, along with the color of the wood, give wood its distinctive beauty—and value. In fact, people have grown to like these patterns so much that when furniture is made with plastic or compressed wood chips, the manufacturers often try to make the furniture look like real wood.

In this activity, the youths in your group will examine household wooden items to learn about tree rings and other features of wood.



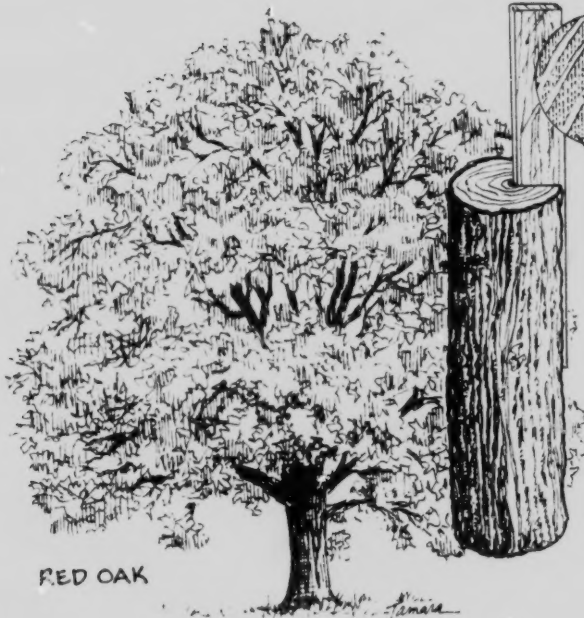
RED PINE



TOY BOAT



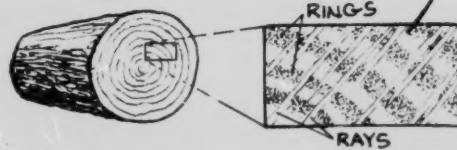
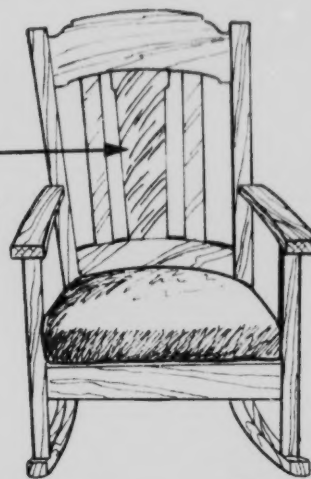
PLYWOOD CABINET



RED OAK

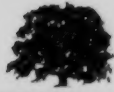


RAY
XYLEM



RINGS

RAY



What Youth Discover

- They see how trees grow by looking at household wooden items and perhaps a tree stump outside.

What You Need

- several wooden items (Cylindrical wooden items, such as baseball bats and the handles of tools, show both cross and lengthwise sections of the wood. Furniture and plywood items also can be used. A tree stump or other cross section of a tree is excellent for demonstrating tree rings. **Note:** Some tropical woods, such as mahogany, do not show clear tree rings.)
- copies of the Tree Rings Activity Record for each group member
- copies of the illustration on page 15 for each group member

What to Do

1. Hand out a copy of the Tree Rings Activity Record and a copy of the illustration on page 15 to each youth.
2. Have the members of your group collect several wooden items from their homes. They also can examine a wooden item in their home, school, or playground that is too heavy to be moved.
3. Can the youths find a cross section of growth rings? This is commonly found at the end of a cylindrical piece of wood, such as a baseball bat or tool handle, or at each end of a board.
4. Can the youths find a lengthwise, or longitudinal, section of growth rings? This is easy to see in boards used for furniture or the side of a bat or tool handle.
5. Can the youths find any knots in the wooden items? Some plywood, such as knotty pine, has very obvious knots.
6. Can the youths find any rays? Some woods, such as oak, have very obvious rays.
7. Have the youths look at plywood items. Why might the lines seen in plywood be far apart?
8. Have each youth complete the Tree Rings Activity Record for each object examined.



Activity 3: Tree Roots

When most people think of roots, they think of large woody plant parts that grow straight down into the ground. Did you know that the roots of many trees grow straight out from the tree just below the surface of the ground instead of down into the soil? By growing straight out from the tree near the surface of the soil, roots are better able to capture water that is seeping down into the soil after a rain or after snow melts. They are also better able to capture nutrients from old leaves and branches that have fallen to the ground or from dead animals that are decomposing.

Scientists who study trees have classified tree roots into two types. The large woody roots you see when you dig a hole in the ground or when a tree is uprooted are one type. These roots support the tree and prevent it from blowing down in a strong wind. Less obvious is the second type—tiny fine roots, often less than a millimeter (less than 1/16 inch) in diameter. These roots take up water and nutrients from the soil for tree growth.

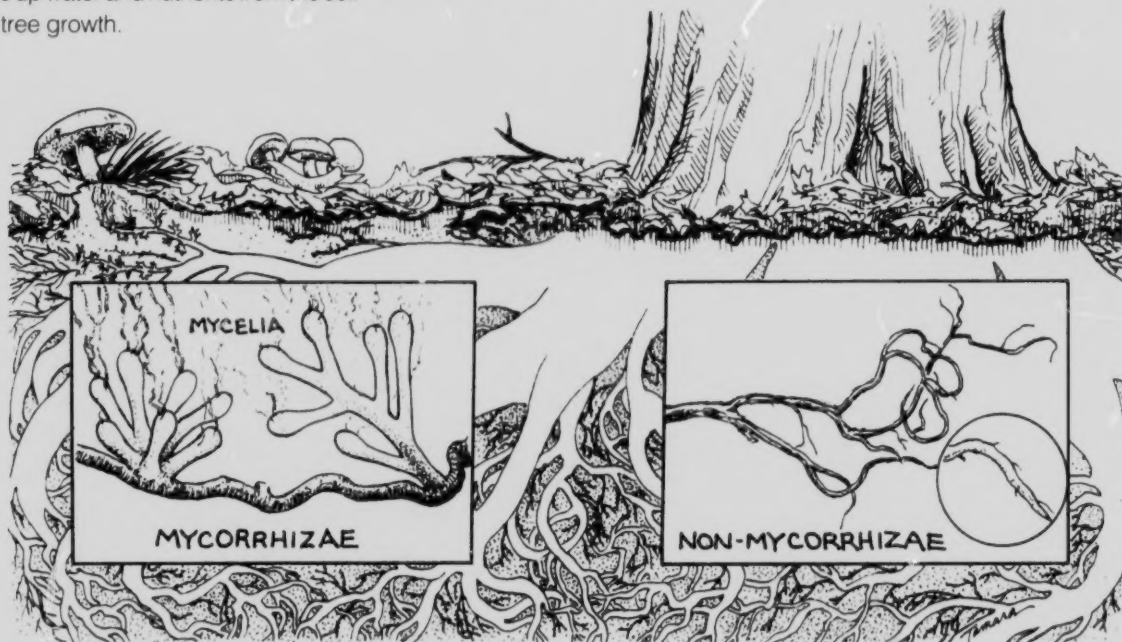
Some fine roots of trees have a very interesting relationship with mushrooms, or fungi. To understand this relationship, you first need to know a little bit about fungi. Many fungi are similar to trees in that they have a part that grows above the ground and a part that grows below the ground. The mushroom is the above-ground part of the fungus. It produces spores, which are blown about by the wind and grow into new fungi. Below the ground is a network of tiny strands called the mycelium. The mycelium grows in the layer of leaves covering the soil (called the litter layer because trees "litter" leaves) and in the upper part of the soil. Similar in function to the fine roots of trees, the mycelium takes up water and nutrients from the litter layer and the soil.

Sometimes the strands of the mycelium of a fungus grow around the fine roots of a tree, forming a "glove" on the finger-like roots in the soil and the litter layer. The mycelium takes up nutrients, which are used by the tree. The fungi in turn receive sugars from the tree. Fungi

don't have green leaves, so they cannot produce their own sugars. The relationship between fungi and tree roots, therefore, benefits both the tree and the fungi. This type of relationship is called a symbiotic relationship.

A tree root that has a fungal glove is called a mushroom root, or mycorrhiza. (In Greek, myco means fungus and rhiza means root.) Mycorrhizae can be distinguished from fine roots without fungal "gloves." Mycorrhizae are generally smoother, shorter, thicker, and enlarged like a small club at the tip. Also, mycorrhizae fork many times, resembling either a hand with many fingers or a feather.

In this activity, you and the youths in your group will look for fine roots and mushroom roots by digging in the litter and upper soil layers. You may find some interesting insects in the litter layer as well. Remember, because dead plants and animals break down and release their nutrients in the litter, this layer is a haven for "hungry" tree roots.





What Youth Discover

- Many fine tree roots are in the litter and upper soil layers.
- Some fine roots have fungal "gloves" surrounding them; these are called mushroom roots, or mycorrhizae.

What You Need

- a wooded area with leaves on the ground
- hand lenses, if available
- a bucket of water
- copies of the Tree Roots Activity Record for each group member

What to Do

1. Hand out a copy of the Tree Roots Activity Record to each youth.
2. Take your group to a wooded area with leaves on the ground. Ask the members to scrape away the leaves carefully until they find some fine roots. These roots are usually in the litter layer or in the upper part of the soil. They are less than 1/16 inch (less than 1 mm) in diameter. The youths also may find some cottony strands growing in the leaves or upper soil. These are the mycelia of fungi.
3. Have the youths collect some of the fine roots and look at them with their hand lenses. Can they find roots that are growing through pieces of old leaves or wood? Explain that most soil nutrients are in dead leaves and branches and in the upper layer of the soil.
4. Have the youths carefully wash the dirt off the roots in a bucket of water.
5. Using the illustration on the Tree Roots Activity Record, explain to your group what mushroom roots are. Ask the members to look for mushroom roots. Have them use hand lenses if available.
6. Have each youth complete the Tree Roots Activity Record.



Section 2. Tree Homes

Activity 4: Live Tree Homes

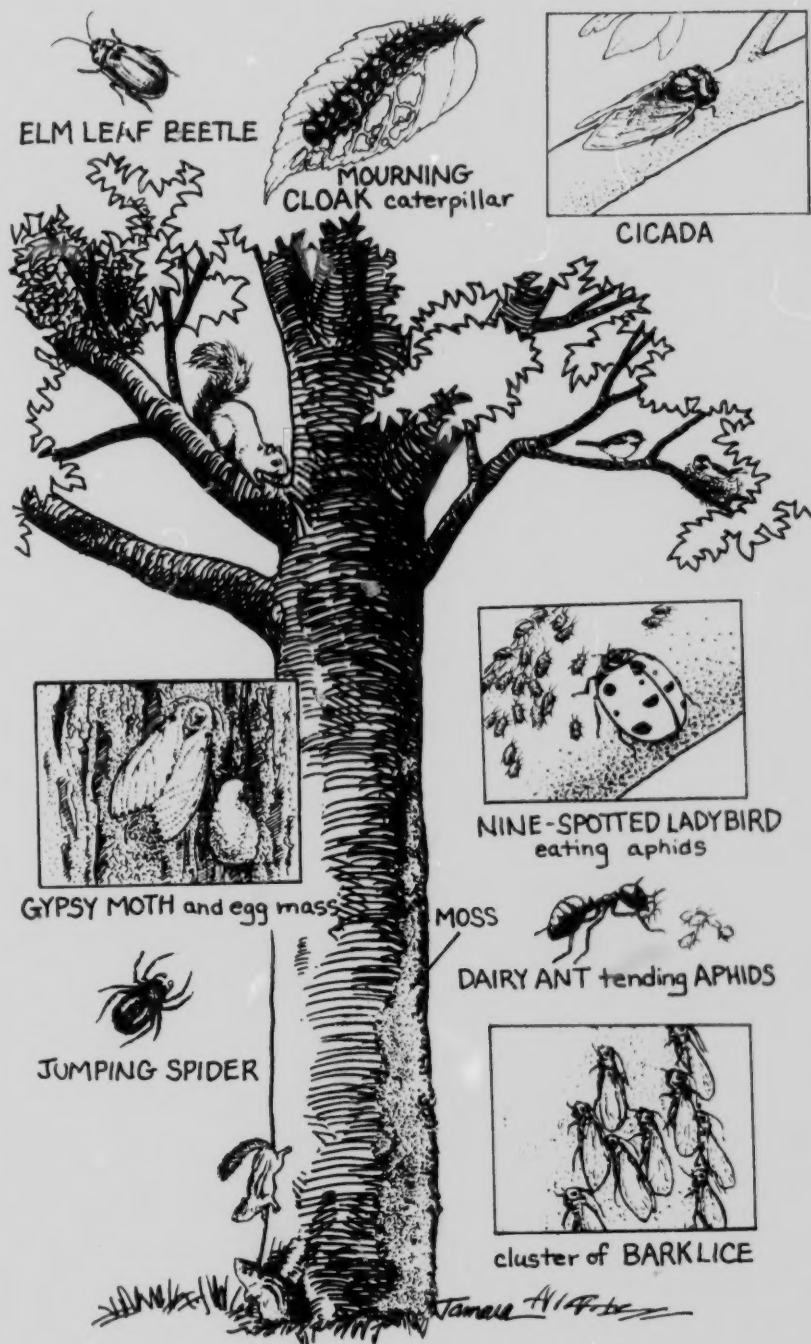
Live trees provide homes for many animals and plants. Hawks, woodpeckers, squirrels, bats, grosbeaks, and robins all make nests in trees. Many smaller animals, such as insects, also inhabit trees. Plants, such as lichens, mosses, and algae, make their homes on the trunks and branches of trees. Fungi may live on the bark, in the wood, on the leaves, and on the roots.

Trees provide many different microhabitats for plants and animals. Microhabitats are small living sites or places that supply food, water, and shelter for plants and animals. The leaves, bark, and roots of a tree provide different foods, moisture conditions, and shelters and are therefore inhabited by different plants and animals.

For example, the leaves and bark of a tree provide many different microhabitats for a variety of insects. Some insects mine, or burrow, into leaves by eating the leaf tissue; these are called leaf miners. Leaf-eating beetles also live on leaves. Leaf-roller caterpillars make homes by rolling leaves into a cylinder. Other insects, such as scales and aphids, live on the bark. Bark beetle larvae live underneath the bark.

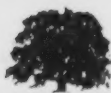
The trunk of a tree offers several microhabitats, which differ in the food, water, and shelter they provide. For example, the north side of a tree is generally wetter than the south side because it is not exposed to the warm sun. That is why you often find more mosses, algae, and lichens growing on the north side.

Different kinds of trees may provide different microhabitats. For example, a tree with smooth, thin bark, such as American beech, will attract insects that pierce the bark to get sap, such as aphids or scales. A tree with a deeply



furrowed bark, such as an oak, provides many sheltered hiding places for large insects and spiders.

In this activity, you and the youths in your group will explore the plants and animals living on a live, healthy tree.



What Youth Discover

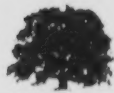
- Many different organisms live on a tree.

What You Need

- live, healthy trees
- hand lenses, if available
- copies of the Live Tree Homes Activity Record for each group member

What to Do

1. Hand out a copy of the Live Tree Homes Activity Record to each youth.
2. Have each youth or group of youths choose a tree to examine. Encourage your group to choose different kinds of trees, such as a broad-leaved and a conifer species.
3. Have the youths identify the different microhabitats on the tree. Have them describe the leaves and bark. Does the top of the tree provide a microhabitat that is different from that provided by the bottom of the tree? Does the bark seem more moist in certain areas, such as inside the furrows or on the north side? Are there scars on the tree where the bark is different?
4. Can the youths find any animals or plants on the leaves or bark? On what parts of the leaves or bark are they living?
5. Can the youths find any signs, such as holes in the bark, that insects or birds live inside the tree?
6. Can the youths find any animals or signs of animals living at the base of the tree? At the top of the tree?
7. Have the members of your group examine lichens, fungi, algae, mosses, and insects with their hand lenses.
8. Have each youth complete the Live Tree Homes Activity Record.
9. Have the youths compare their findings from different trees.

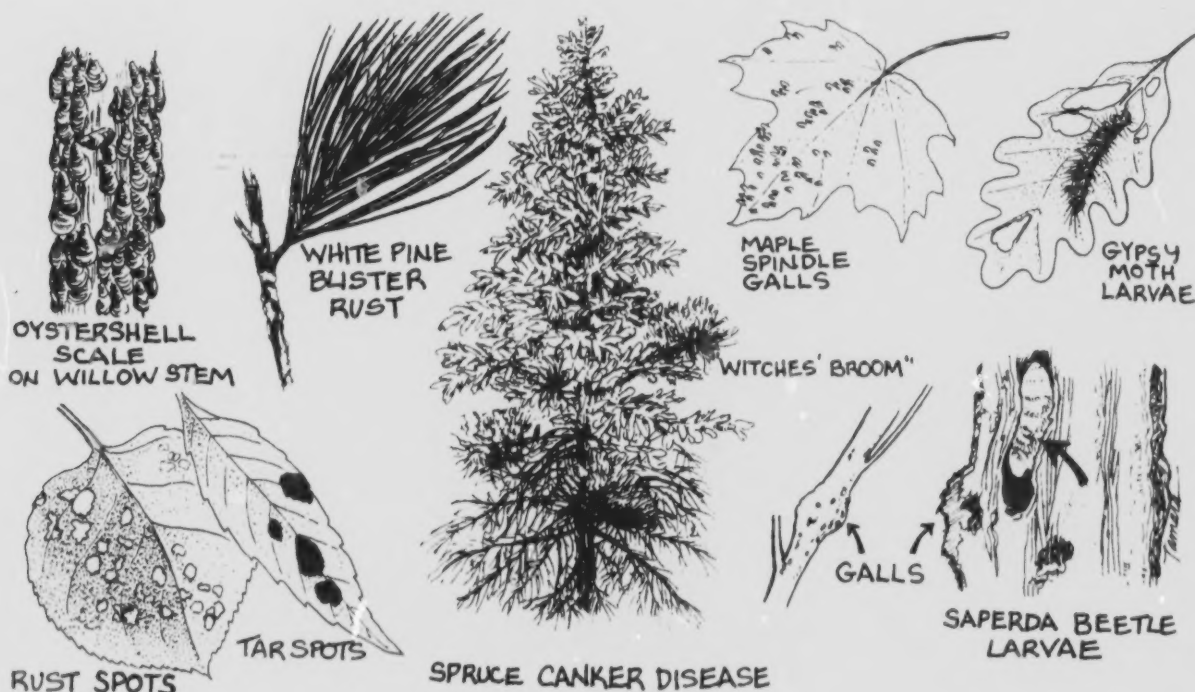


Activity 5: Snags

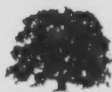
The plants and animals that live on diseased trees or snags (dead trees) are different from those that live on healthy trees. Diseased trees and snags are more likely than live trees to be inhabited by fungi and to have cavities, which provide nesting sites for animals. In fact, snags provide such a valuable habitat for wildlife that the United States Forest Service has started the "Animal Inn" campaign to make the public aware of the value of snags and to encourage people to leave snags standing.

Dead trees provide shelter or food for sixty-five species of birds, thirty species of mammals, two species of amphibians, and many, many insects. Cavity nesters include woodpeckers, honey bees, flying squirrels, and raccoons. Bats use the cracks of loosened bark for roosting and raising their young.

There are many reasons trees die. In fact, a combination of several factors usually kills a tree. For example, acid rain or car exhaust can weaken a tree, making it more susceptible to diseases or insects. A leaf-eating insect such as a gypsy moth may then attack a weakened tree and kill it. Some major tree diseases are illustrated here.

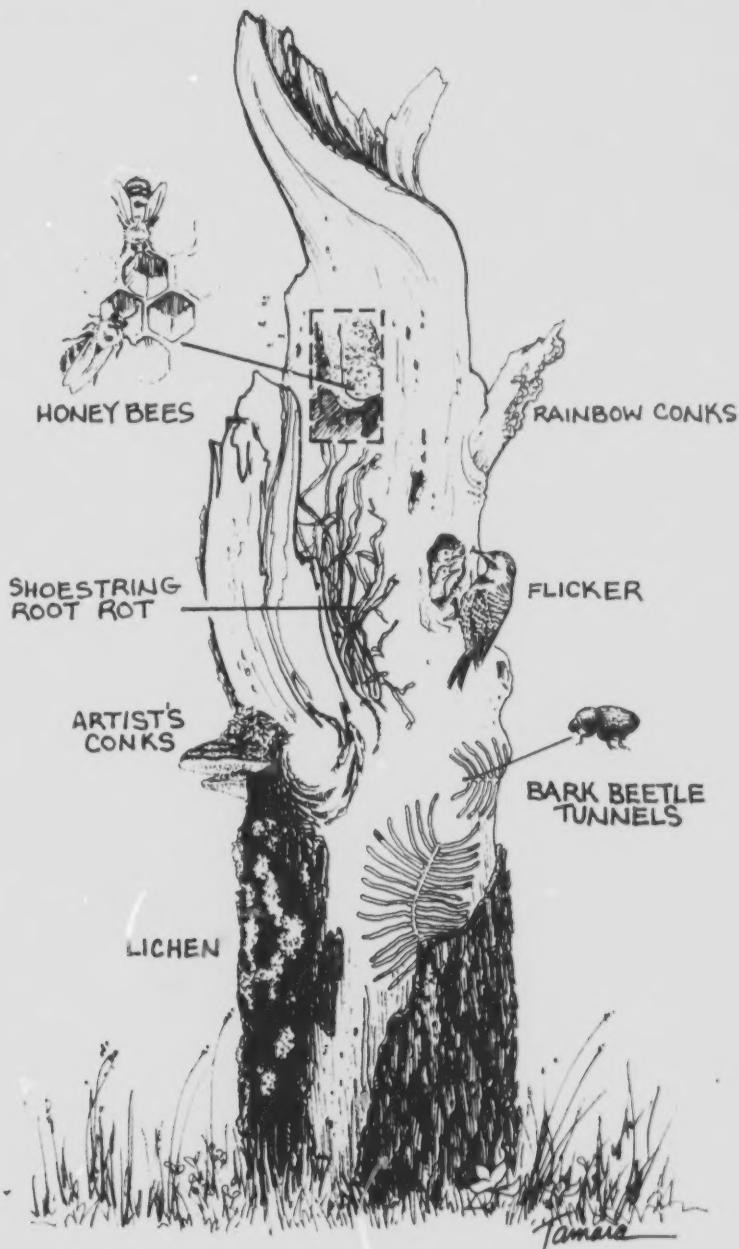


Examples of tree diseases



In this activity, you and the youths in your group will examine the community of organisms that live on a diseased tree or snag. You will look for the mycelia of fungi and the galleries of beetles. Galleries are tunnels made by insects such as bark beetles that live underneath the bark. They are seen as squiggly lines on the trunk beneath the bark. Each species of bark beetle has its own characteristic gallery. You also may want to investigate what is killing or might have killed the tree.

Caution: Dead and diseased trees can be dangerous! Be extremely careful when examining a diseased tree or snag. Watch out for dead branches, which could fall. Be sure to conduct this activity on a calm day to avoid the high risk of a dying tree or snag blowing over.





What Youth Discover

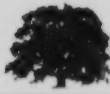
- Many different organisms live on a dead or diseased tree.
- Trees die for many reasons.

What You Need

- diseased or dead trees and a calm day
- hand lenses, if available
- a knife to peel back bark
- copies of the Snags Activity Record for each group member

What to Do

1. Hand out a copy of the Snags Activity Record to each youth.
2. Have each youth or group of youths choose a diseased tree or snag to examine.
3. Have the youths identify the different microhabitats on the tree. Have them describe the bark. Are there areas on the tree where the bark has fallen off?
4. Ask the youths to look carefully for cavities in the trunk or branches where animals might live. *Caution: Do not let the youths climb on the tree. Do not examine limbs that could fall.*
5. Can the youths find any animals or plants on the bark? Are there any signs, such as holes in the bark, that insects are living or have lived inside the tree?
6. Have the youths peel back the bark and look for insects and fungi underneath. Can they find squiggly lines on the trunk underneath the bark? Explain that these lines, called galleries, are made by bark beetles or wood-boring beetles as they tunnel through the wood. White cottony strands are likely to be the mycelia of fungi.
7. Have the youths examine lichens, fungi, algae, and insects with their hand lenses.
8. Can the youths find any evidence of what might be killing (or might have killed) the tree? Refer to the illustrations of tree diseases.
9. Have each youth complete the Snags Activity Record.
10. Have the youths compare their findings from different trees.

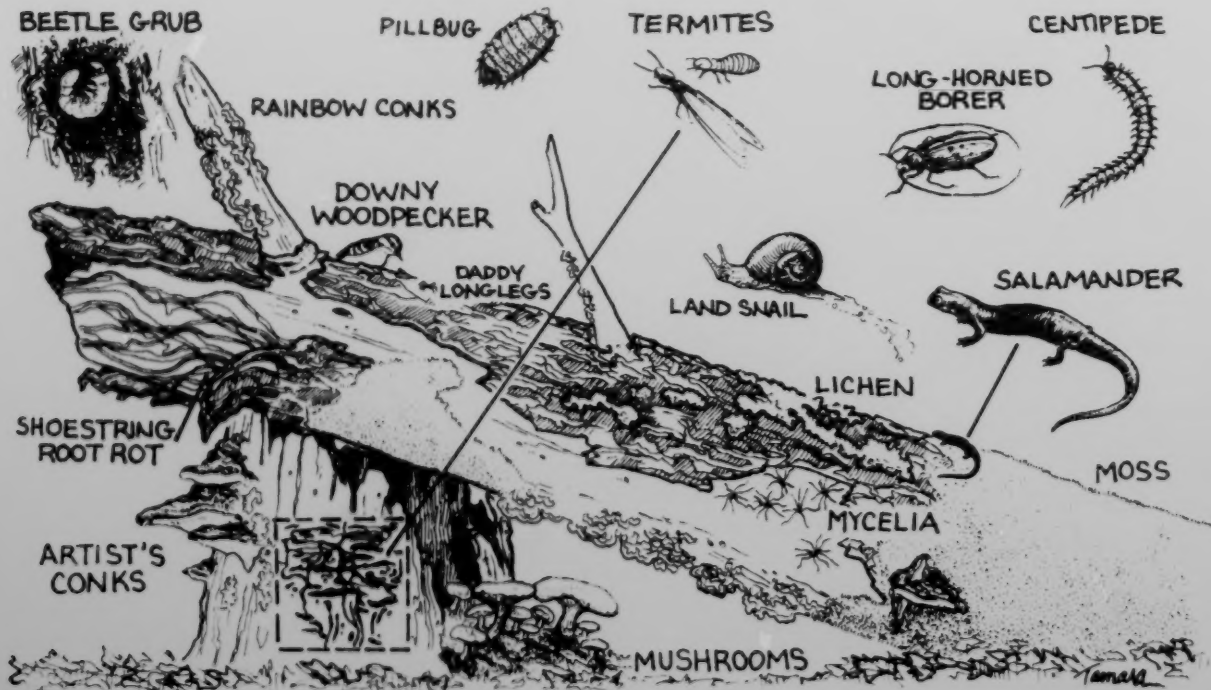


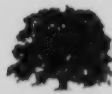
Activity 6: Rotting Logs

The plants and animals living in a log rotting on the ground are different from those living on a healthy tree or even a diseased tree. Many fungi thrive in the moist decaying wood of a rotting log. These fungi are, in turn, eaten by insects and other small animals. Other animals, such as beetles, carpenter ants, and termites, feed directly on the rotten wood. As the log becomes softer and soggy, snails, slugs, millipedes, centipedes, worms, and pill bugs invade. Spiders and red-backed salamanders may find shelter in and underneath the log during the day and prey on the insects and other small

animals inhabiting the log at night. As these plants and animals make small cracks and holes in the wood, more plants and animals enter and, in turn, break down the wood even more. After many years, the log will be completely broken down into rich organic soil.

In this activity, you and your group will explore the variety of life on a rotting log. In cities, it may be difficult to find rotting logs because they are considered dangerous or unsightly and are removed. You may find a rotting log in a city park that is left in a natural state. Finding rotting logs in forested areas will not usually be a problem.





What Youth Discover

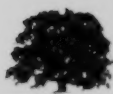
- Many different plants and animals live in a rotting log.

What You Need

- a rotting log
- hand lenses, if available
- a knife to peel back bark
- a jar or bug box, available from nature stores or biological supply houses (optional)
- copies of the Rotting Logs Activity Record for each group member

What to Do

1. Hand out a copy of the Rotting Logs Activity Record to each youth.
2. Have each youth or group of youths choose a rotting log to examine.
3. Have the youths identify the different microhabitats on the log. Have them describe the bark. Are there areas on the log where the bark has fallen off?
4. Have the youths examine the wood. Is it still hard or is it soggy?
5. Ask the youths to look for cavities in the log where small mammals such as chipmunks might nest.
6. Can the youths find insects or other small animals or plants on the surface of the log?
7. Have the youths peel back some of the outer layers of the log to look for animals living in the log. Are there tunnels in the log? These could have been made by carpenter ants, termites, bark beetles, or wood-boring beetles. White cottony strands are likely to be the mycelia of fungi.
8. If there are places on the log where the wood is still hard and places where it is soft and soggy, ask the youths to examine both areas to see if the plants and animals in each place differ.
9. Have the youths examine lichens, fungi, algae, mosses, insects, and other small animals with their hand lenses. They may want to put the insects into a jar or bug box to examine them more easily.
10. Have each youth complete the Rotting Logs Activity Record.
11. Have the youths compare their findings from different logs.



Section 3. The Future Forest

Activity 7: Forest Gaps

When a tree falls over in a forest, a gap is formed in the trees at the top of the forest. This gap allows more light and warmth to reach the forest floor. If the root system of the tree was upturned when the tree fell over, then the soil in the gap may be different from the surrounding soil. The soil in the gap is likely to be mineral soil, which contains less organic material than the soil in the surrounding forest.

Conditions in gaps, including light, warm temperatures, and mineral soil, are favorable for the sprouting of new seeds and the growth of seedlings. (Seed-

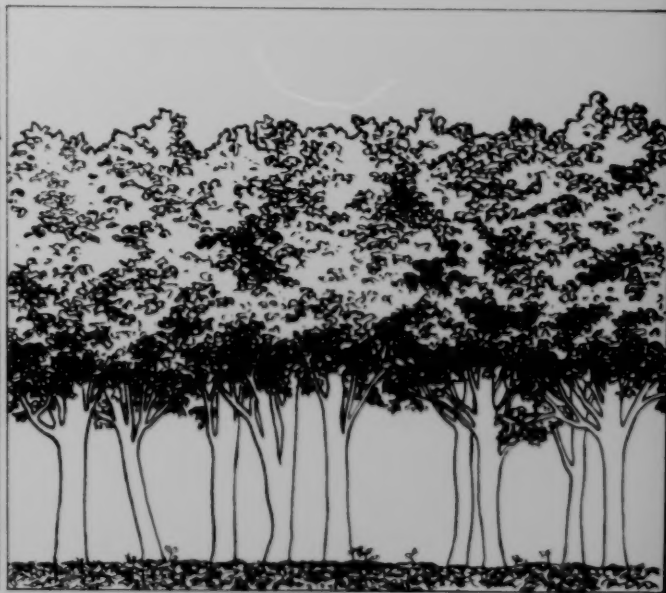
lings are young trees that have grown no higher than your waist.) In areas where there are no gaps, seedlings also may be present, but they may take longer to grow. In addition, the kinds of seedlings that grow in gaps may be different from those that grow in the shady areas of the forest.

Seedlings that are common in shady areas include sugar maple, American beech, red spruce, and balsam fir. In gaps large enough to permit a lot of light to reach the forest floor, American ash and basswood are common. If mineral soil is exposed in a gap, then birch and aspen may become established.

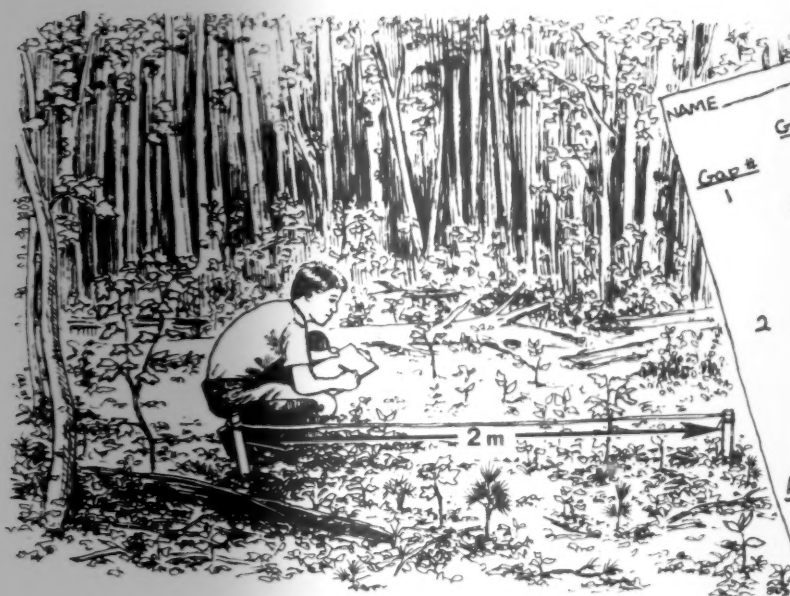
Most seedlings in an intact forest, and even in a gap, die before they reach maturity. But some, especially those in gaps, grow into large trees. These seedlings are the next forest.

It is important for foresters to know what kinds of seedlings and how many are growing in a forest. If few natural seedlings are on a site, then a forester may want to plant some to ensure that the future forest is productive.

In this activity, you and your group will learn about seedlings in a forest. In cities, seedlings may be difficult to find because sprouted seeds are often killed by mowing or trampling. You may find seedlings in a natural area of a city park.



When a tree falls over in the forest a gap is formed, creating conditions favorable for the growth of small trees.



NAME _____ DATE _____

Gap Area Forest	
Gap #	Seedlings
1	Basswood American Ash Birch White Pine
2	Beech American Ash

Intact Forest (Non-Gap)	
Area #	Seedlings
1	Sugar Maple White Pine Balsam Fir

Number

4
2
1
5
3

1
1
2

What Youth Discover

- Seedling growth in forest gaps is different from that in areas where there are no gaps.

What You Need

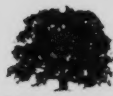
- a small wooden or metal stake
- a tape measure at least 2 meters (75 inches) long with a loop at the end large enough to go over the stake, or a piece of string 2 meters long with a loop at the end
- copies of the Forest Gaps Activity Record for each group member

What to Do

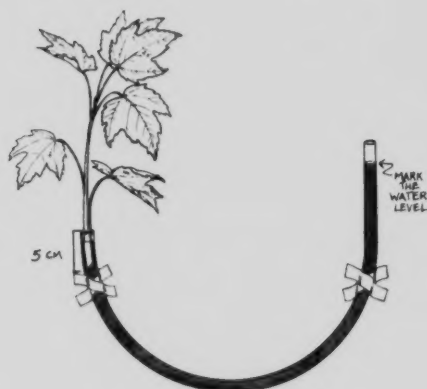
- Hand out a copy of the Forest Gaps Activity Record to each youth.
- Take your group into a forest. Have the youths find at least two sites where several trees have fallen, creating a gap, and at least two sites where there is no gap (intact forest).
- Have the youths put the stake into the ground in the center of the gap.
- Have the youths loop the string or tape measure over the stake.
- Have the youths lay out the string or tape on the ground and put a stick in the ground at the end. Have them visualize a circle with a 2-meter radius around the stake.
- Ask the youths how many seedlings (woody plants less than waist high) they see in the

imaginary circle around the stake. (To make this step easier, have them walk the string around the stake in a complete circle, stopping each time the string crosses over a new seedling.) If they know the name of each kind of seedling, have them write it down on their record sheets. Otherwise, have them make up names.

- Have the youths list the different kinds of seedlings in the circle and record the number of each kind on their record sheets.
- Have the youths repeat steps 2 through 6 in several other gaps and then in forest areas that are not gaps.
- Have each youth complete the Forest Gaps Activity Record.
- Have the youths compare their results from the gaps and the areas of intact forest.



Trees and Water Activity Record



Name: _____ Date: _____

From what type of tree was your branch cut?

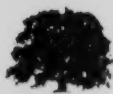
How many inches (or centimeters) of water were lost from the tube with a branch in the sunny location?

If you had a tube with no branch, how many inches or centimeters of water were lost from it?

If you had a tube with a branch in a shady or cool location, how many inches or centimeters of water were lost from it?

Why do trees need water?

Why do trees use more water on a sunny day? (Hint: Are the leaves of trees more active on sunny or cloudy days?)



Tree Rings Activity Record

Name: _____ Date: _____

What objects did you examine?

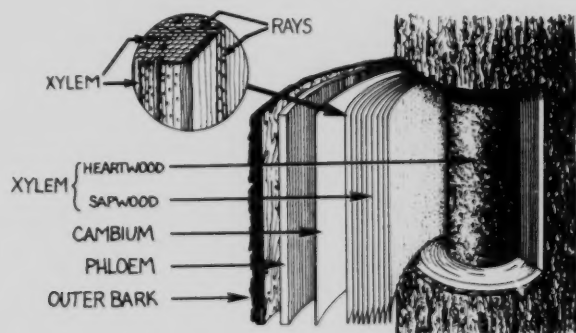
Did you see a cross section of tree rings? Draw the cross section. Are rays present?

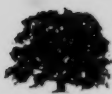
Did you see areas where the rings are close together and areas where the rings are far apart?

Why might the rings be close together for several years?

How many years of growth does the cross section represent?

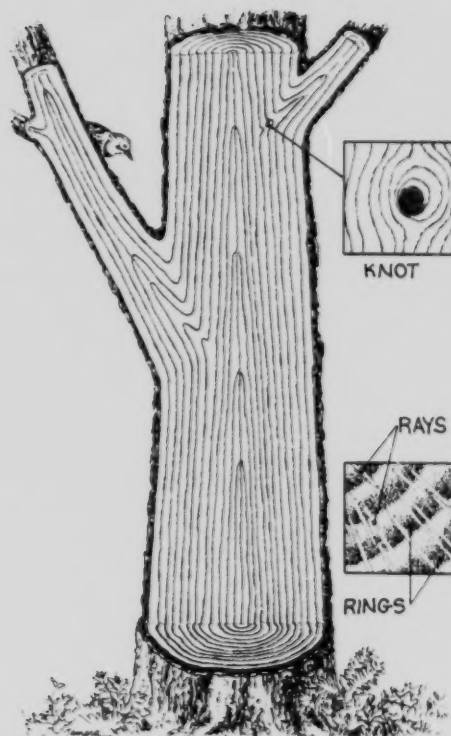
Did you see a lengthwise, or longitudinal, section of a tree? Draw a portion of the longitudinal section. Are rays present?





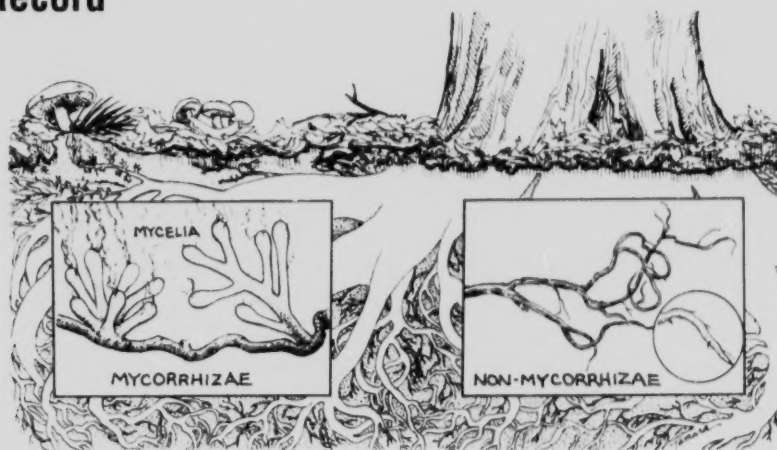
Did you find knots in a piece of wood? What caused the knot to form? Draw the knot.

Optional: How do tree rings form in a living tree?





Tree Roots Activity Record



Name: _____ Date: _____

Where did you find the roots? In the litter layer or in the soil?

Draw the fine roots and mushroom roots that you found.

How do mushroom roots differ from fine roots? Describe the differences in color, shape, and texture.

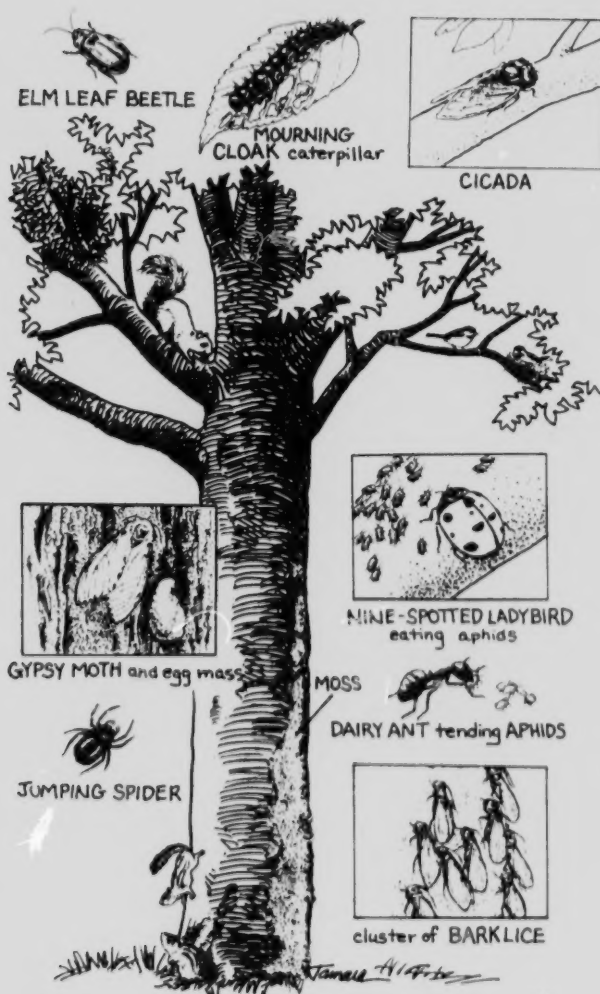
Did you find any decaying seeds or twigs in the litter layer or in the top layer of the soil? Any insects?

Why are fine roots and mushroom roots found in fallen leaves or at the very top of the soil? (Hint: Decaying leaves, branches, and animals break down and release their nutrients there.)



Live Tree Homes Activity Record

Name: _____ Date: _____



Can you name the tree you examined?

Describe and draw the leaves of your tree.

Describe and draw the insects you saw on the leaves.

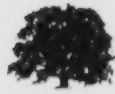


Describe and draw the bark of your tree. Is it smooth or furrowed?

Describe and draw the insects or spiders you found on the bark. Where on the bark did you find them?

Describe and draw any evidence of animals having been on the tree. (Hint: Holes in bark are made by insects burrowing into or out of a tree or by birds trying to locate insects in a tree.)

Describe and draw any fungi, lichens, mosses, or algae you saw on the bark. Where on the bark did you find these plants? Why there? (Hint: The north sides of trees or the insides of furrows are usually wetter than the south sides of trees or the tops of ridges on the bark.)



Snags Activity Record

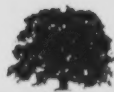
Name: _____ Date: _____

Can you name the tree you examined?

Describe and draw the bark of your tree. Is it smooth or furrowed?
Has it fallen off in places?



Describe and draw the insects or spiders you found on the bark or underneath the bark.



Describe and draw any evidence of animals having been on the tree. For example, squiggles on the trunk underneath the bark are the galleries of bark beetles or wood-boring beetles.

Describe and draw any fungi, lichens, or algae you saw on the bark.

Describe and draw any fungi (white cottony fibers) you found underneath the bark.

Did you find any rotten wood underneath the bark?

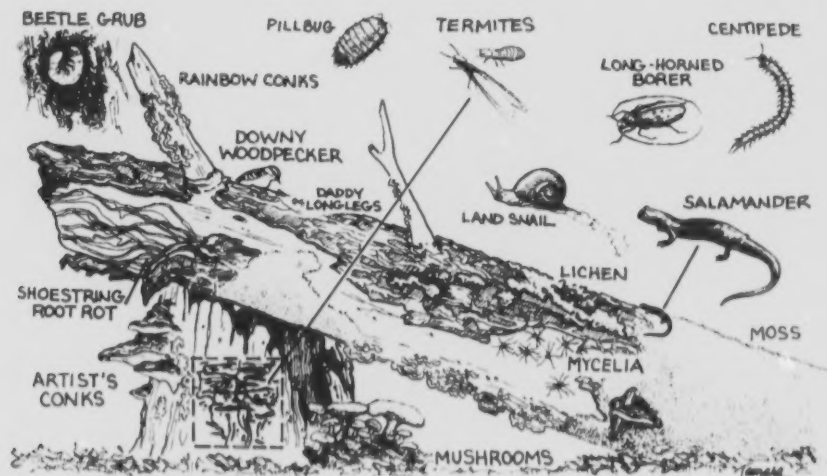
Did you find any evidence of what might have killed this tree?

What are the benefits of snags?

What are the disadvantages of leaving snags standing? (Hint: Dead trees can fall over or their branches can fall off, injuring people nearby.)

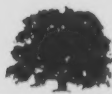


Rotting Logs Activity Record



Name: _____ Date: _____

Describe and draw the log you examined. Is there any bark left? Is the wood hard or soft and soggy?



Describe and draw the insects, spiders, and other small animals you found on or in the log.

Describe and draw any evidence of animals being on the log (for example, the tunnels, sawdust, and squiggles, or galleries, of bark beetles or wood-boring beetles).

Describe and draw any fungi, lichens, mosses, or algae you saw on or in the log.





List the different kinds of seedlings and the numbers of each that you found in each area of intact forest (nongap area).

Intact Forest (Nongap) Area #	Seedlings	Number
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

How many different kinds of seedlings did you find in gaps?

How many different kinds of seedlings did you find in areas of intact forest?

Were the kinds and numbers of seedlings you found in gaps different from the kinds and numbers you found in areas of intact forest? Can you explain why there might be differences?

Were the seedlings larger in the gap or in the intact forest?



Trees: Dead or Alive Project Record

Name: _____ Date: _____

What do trees need to grow?

Draw a diagram of a cross section of a tree. Label the tree rings, xylem, cambium, phloem, sapwood, and heartwood.

Describe the relationship that exists between fungi and roots in mushroom roots.

Can you name some birds that build nests in trees? Some birds that depend on trees for food?



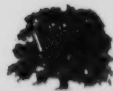
Can you name some mammals that build nests in trees? Some mammals that depend on trees for food?

Can you name some insects that live in trees? In what parts of the tree do these insects live?

Are the animals and plants that live on healthy trees different from those that live on snags? Why? Are the animals and plants that live in rotting logs different from those that live on healthy trees and on snags?

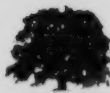
Why are gaps important in a forest?

What did you learn from this project?



Suggested Field Trips and Activities

1. In the spring, take your group on a field trip to see a maple syrup operation.
2. Have the members of your group gather the seeds of several different species of trees. Ask them how the different seeds might be dispersed, or carried away, from the parent tree to a location where they can sprout and grow. For example, acorns, beech nuts, and other nuts are dispersed by squirrels and other animals. Maple, ash, poplar, and other light seeds with "wings" or "cotton" are dispersed by wind. Mountain ash berries, cherries, and other fruits are largely dispersed by birds. The youths might want to put identification marks on maple and other wind-dispersed seeds, then drop them out a second-story window on a breezy day to see which seeds travel the farthest. (*This activity should be supervised.*)
3. Have the youths identify the trees in their backyard, school yard, or neighborhood. Field guides such as *Know Your Trees* will help them.
4. Have the youths plan and (or) participate in Arbor Day activities. Suggest they go to the library and find out about the history of Arbor Day.
5. Have your group form a forestry club and train to participate in the National 4-H Forestry Invitational competition. Details about this event can be obtained from your county Cornell Cooperative Extension office.
6. Have the youths grow trees from seeds or cuttings. A local nursery can suggest suitable trees.



Glossary

broad-leaved tree: A tree with wide leaves, as opposed to trees with needlelike leaves. Examples of broad-leaved trees are oak, maple, ash, and poplar.

cambium: The layer that produces the xylem and phloem layers.

carbon dioxide: A gas that is essential for plants.

cavity: In this guide, a hole in a tree.

circumference: The length of the outer boundary of a circular area such as the trunk of a tree.

community: A group of plants and animals that live in one particular area.

cross section: In this guide, the view of the tree you get by cutting across, or perpendicular to, the length of the tree.

earlywood: The light band of xylem produced by trees growing quickly in the spring.

ecosystem: The combination of living things (e.g., plants and animals) and nonliving things (e.g., soil, water, air) in an area.

fine roots: Very small roots, usually less than 1/16 inch (less than 1 mm) in diameter, that absorb nutrients and water from the soil.

fungi: Organisms such as mold, yeast, and mushrooms that feed on living things (such as tree roots and leaves) or dead organic matter. Some fungi cause diseases in trees; others may help trees absorb nutrients from the soil.

furrowed: Having deep grooves.

gallery: In this guide, the tunnels created by insects such as bark beetles living underneath the bark of trees.

gap: In this guide, the opening in a forest resulting from one or several fallen trees.

habitat: An area that provides food, water, and shelter for an animal.

heartwood: The inside portion of the tree that is no longer living. Heartwood is made up of old xylem, which is no longer able to transport water.

intact forest: An area of forest where there is no gap, or opening in the top of the forest.

knot: A hard portion of wood formed where a branch comes out of the trunk.

latewood: The dark-colored band of xylem produced by trees during the summer when growth slows.

litter: The layer of leaves and fallen twigs and branches on top of the soil.

longitudinal section: In this guide, the view of a tree you get by cutting lengthwise, or up and down the trunk.

microhabitat: A very small area that provides food, water, and shelter, such as a leaf or a furrow in the tree bark.

mushroom: The part of a fungus that produces spores, which spread the fungus to other areas.

mushroom root: See mycorrhiza.

mycelium (plural: mycelia): The part of the fungus that absorbs nutrients and water. The mycelium consists of thin, white, cottony strands that are often branched, and it is common in soil, litter, and rotten wood.

mycorrhiza (plural: mycorrhizae): The association of the fine roots of a tree with the mycelium of a fungus, whereby the fungus helps the tree absorb nutrients from the soil and the tree provides sugars for the fungus.

organism: A living thing.

oxygen: A gas that is essential for animals and plants and which is given off by actively photosynthesizing plants.

phloem: The layer just inside the bark that transports sugars from the leaves to other parts of the tree.

photosynthesis: A chemical process whereby green leaves use the sun's energy to make sugars that are used in the growth of the plant.

radius: The length from the center to the outside of a circle.

rays: The part of the tree that stores food and transports food across the rings to the bark.

sapwood: The outermost layer of xylem, which transports water and minerals up the tree.

seedling: In this guide, a young tree that is less than waist high.

snag: A dead tree that is still standing.

symbiosis (or symbiotic relationship): An association between two organisms that benefits both. For an example, see mycorrhiza.

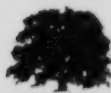
transpiration: The process whereby water is lost from leaves during photosynthesis.

transpire: To give off water, especially through leaves.

tree ring: The circular band laid down each year by a growing tree. The number of tree rings indicates the age of the tree, and their widths indicate how fast the tree has been growing. Best seen in a cross section of a tree.

wood: The part of the tree underneath the bark consisting of live and dead xylem.

xylem: The layer inside the phloem that carries water and minerals up the tree.



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